Space Weather Technical Forecast

Issued on Friday, 04 August 2023 at 13:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares (R1-R2; Minor-Moderate radio blackouts) likely Day 1 (04 Aug) but risk reducing. CME effects likely with a chance of G1/Minor Storm activity throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has remained at Moderate levels with one M-class flare observed, peaking at M1.9 at 04/0424 UTC from AR3386 in the northwest. Nine numbered sunspot regions feature on the visible disc. The largest region likely remains AR3380 (Dac/Beta-Gamma-Delta) on the southwest limb though it is now transiting off the visible disk. AR3386 in the northwest is the second largest region and has also seen little significant change in recent hours, with minor reorganisation of the intermediate spots. Remaining regions, including those that have recently rotated on from the eastern limb, appear generally stable or are in slow and erratic decay.

The M1.9 flare from the northwest disk around 04/0420 UTC and likely associated filament lift off, produced a CME which has been modelled as presenting a risk of a glancing blow into Day 4 (7th Aug).

Solar Wind / Geomagnetic Activity: The solar wind at L1, as measured by ACE/DSCOVR was slow-ambient to slightly elevated, generally between 330 and 350 km/s but increasing to 420-450km/s from around 04/0900 UTC. Density was near or below average. The total interplanetary magnetic field strength (Bt) was at weak levels to start becoming Moderate from 03/1430 UTC, and occasionally Strong from 04/0700 UTC, with a peak of 16.23nT at 04/0808 UTC following another upwards step change. The north-south component, Bz, was generally weakly positive but with a moderate southward directed orientation between 04/0700 UTC and 04/1130 UTC and a minimum of -8 nT. Phi angle was negative (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was at mostly background levels, peaking at 126 pfu at 03/1855 UTC. The associated 24-hour integrated fluence remained below the Active level (1e8 integrated pfu), with 1.11e6 integrated pfu noted at 04/0000UTC, and now has a flat trend.

Four-Day Space Weather Forecast Summary
Solar Activity: Activity is likely to be Low to Moderate, with the most likely in the immediate term from the departing region on the southwest limb, AR3380.

Solar Wind / Geomagnetic Activity: The Geomagnetic forecast remains complex with multiple CME impacts possible. Glancing CME influence anticipated on Day 1 (04 Aug), possibly already being felt. In addition a full-halo CME which left the Sun around 02/0900 UTC is considered to arrive Day 2 (5th Aug) or perhaps early into day 3 (6th Aug). A recent flare also produced a CME which has been modelled as presenting a risk of a glancing blow into Day 4 (7th Aug).

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Solar winds have been generally slow-ambient, with some minor enhancement being felt from likely connection to a weak high speed stream (HSS). In the absence of any CME enhancement solar winds most likely remaining similar though the period. CME impacts however, most reliably from the 02/0900 UTC CME, could see solar winds reaching slightly elevated or perhaps elevated levels at times, 500-550km/s, particularly if they combine with HSS enhancement.

Geomagnetic activity generally Quiet (Kp 1-2) but Unsettled to Active (Kp 3-4) intervals expected and a chance (20-30%) of G1/Minor Storm intervals throughout.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is currently at background levels. There is a slight chance of enhancement from any notable flares that occur, most likely emanating from AR3380 in the near term. The high energy electron flux (greater than 10 MeV) is expected to remain at normal background to moderate levels through the period. The associated fluence therefore remaining below the Active threshold (1e8 total pfu).

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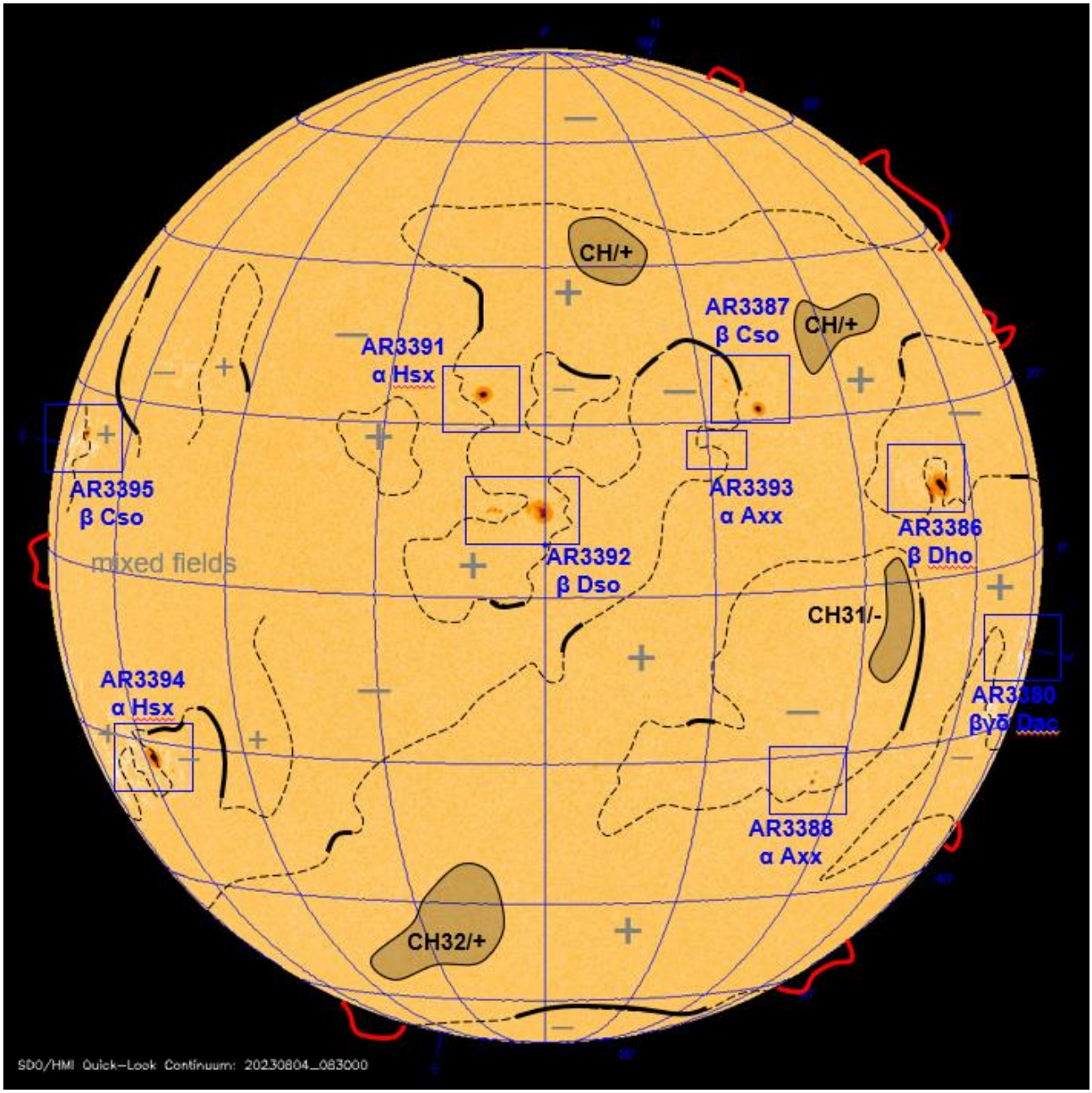
Figure 1. Solar Analysis Valid 04/0830 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The Geomagnetic forecast remains complex with multiple CME impacts possible. A solar filament lifting off the sun's surface was observed centre disc around 31/1800 UTC, alongside a C5 flare from AR3380 with a likely associated CME appearing towards the southwest. In addition, two filament lift offs from the northeast disc produced a CME towards the northeast. Both of these are considered to have an Earth directed component, with influence anticipated on Day 1 (04 Aug), possibly already being felt. In addition to these two CME, a full-halo CME left the Sun around 02/0900 UTC. This is considered to arrive Day 2 (5th Aug) or perhaps early into day 3 (6th Aug). A long period M1.9 flare from the northwest disk around 04/0424 UTC and likely associated filament lift off produced a CME which has been modelled as presenting a risk of a glancing blow into Day 4 (7th Aug).

Solar winds have been generally slow-ambient, with some minor enhancement being felt from likely connection to a weak high speed stream (HSS) from either CH31/- or perhaps an unnumbered CH/+ in the northwest disc. Both these features are low confidence however they are coincident with more well defined and likely stronger coronal holes on the previous rotation. In the absence of any CME enhancement solar winds most likely remaining similar though the period. CME impacts however, most reliably from the 02/0900 UTC CME, could see solar winds reaching slightly elevated or perhaps elevated levels at times, 500-550km/s, particularly if they combine with HSS enhancement. Geomagnetic activity generally Quiet (Kp 1-2) but Unsettled to Active (Kp 3-4) intervals expected and a chance (20-30%) of G1/Minor Storm intervals throughout.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	30	30	20
Strong	G3	No	1	5	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/0701	Partial	Filament eruption	NE	599 km/s	04/0300 UTC	Glancing blow
01/0827	Full	Filament eruption	SW	424 km/s	04/1400 UTC	Glancing blow
02/1600	Partial	Filament eruption	Centre Disk	520 km/s	05/2300 UTC	Direct hit possible
04/0925	Partial	Flare	NW	590 km/s	07/1400 UTC	Glancing blow likely

Figure 2: Latest MOSWOC ENLIL model ensemble output

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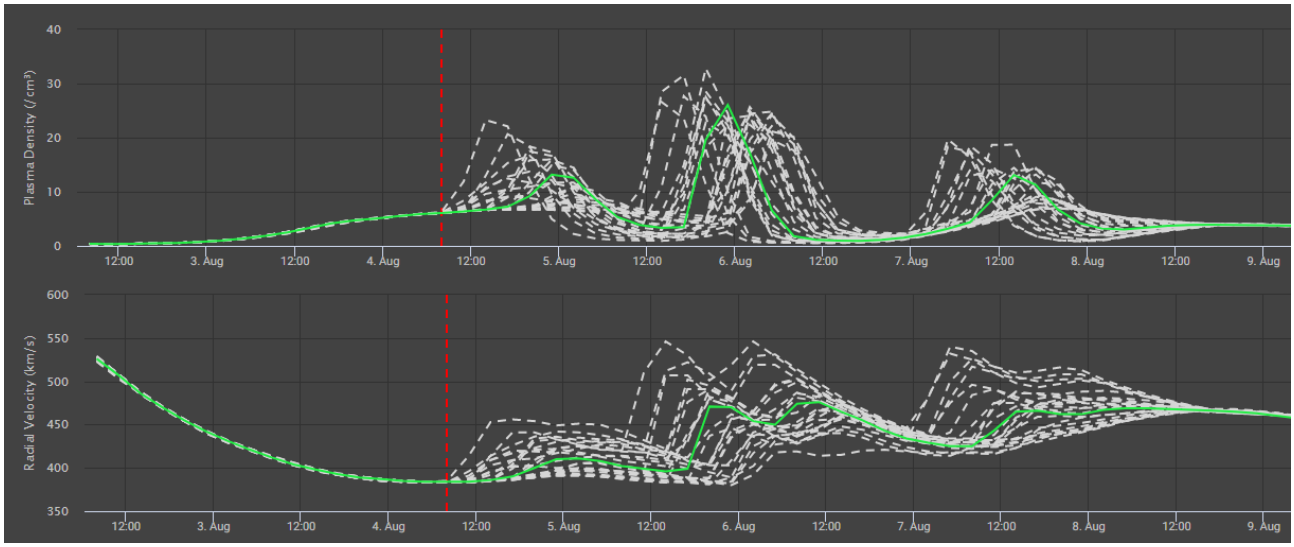

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Radio Blackouts - X-Ray Flares:
Nine numbered sunspot regions feature on the visible disc. The largest region likely remains AR3380 (Dac/Beta-Gamma-Delta) on the southwest limb though it is now transiting off the visible disk. AR3386 in the northwest is the second largest region and has seen some areal growth and flare activity in recent hours. Remaining regions, including those that have recently rotated on from the eastern limb, appear generally stable or are in slow and erratic decay. Activity is expected to be Low to Moderate, with the most likely source of flare activity in the immediate term still AR3380, with the full departure of this feature through days 1 and 2 seeing the largest reduction in flare risk. Two other moderately large regions AR3386 and AR3392 in the northwest and centre disk respectively, contribute much of the risk of any further M-class flares. The arrival of further active regions across the eastern limb is anticipated to be most probable later in the period.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	60	40	30	30
Very Active	R3 to R5 X Class	No	10	5	5	5

Figure 3: Latest 24hr X-ray flux

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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux is at background levels. The main risk of enhancement and exceedance of the S1/Minor Storm threshold, comes mostly from the complex region AR3380 departing the limb of the southeastern edge of the visible disc. This risk reducing into Day 2 onwards.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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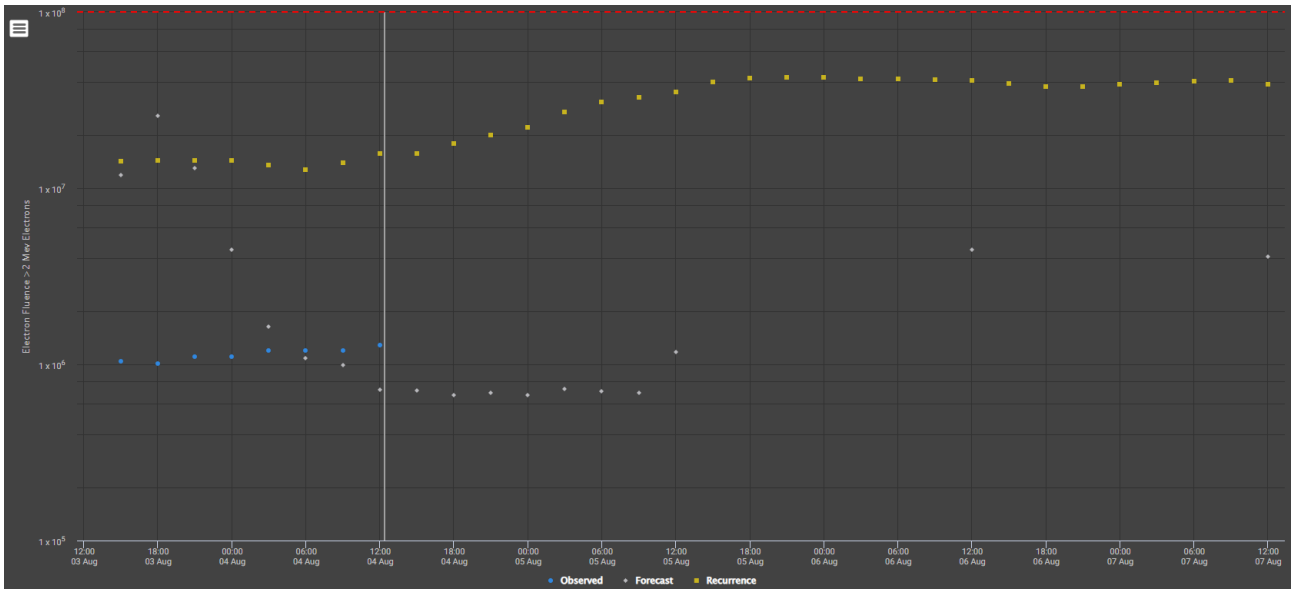
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 10 MeV) is currently expected to remain at normal background to moderate levels through the period, as CME potential and the lack of significant high speed streams lead to likely suppressed flux values.

The associated 24 hour fluence is forecast to remain below Active (1e8 total pfu). The Met Office REFM output is currently giving reasonable guidance for initial conditions, but confidence in the model lowers as the period advances.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output



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